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Project Summary

Proceedings: Fourth Symposium on Fugitive Emissions: Measurement and Control (New Orleans, LA, May 1980)

C. S. Wibberley, Compiler

The volume of proceedings is a compilation of 24 technical papers presented by authors from government agencies, consulting and research organizations, and industrial concerns at the Fourth Symposium on Fugitive Emissions: Measurement and Control on May 28-30, 1980, in New Orleans, Louisiana.

The papers describe recent developments in the field of industrial fugitive emissions measurement and control, including:

- summaries of the impact of fugitive emissions on EPA regulatory programs and of Federal Regulations and Policies on particulate matter fugitive emissions under the Clean Air Act;
- the results of recent fugitive emissions measurement programs at a surface coal mine, petroleum refineries, a particle board plant, a steel mill, a copper smelter, and a pilot oil shale retort;
- methodologies developed for measuring emissions from a hazardous waste treatment facility and a blast furnace cast house, and for obtaining an inventory of emissions from utility coal handling operations;
- the development of an isokinetic electrostatic particulate matter sampler and a horizontal elutriator for sampling particulates in the inhalable size range;
- the development and refinement of techniques for determining the effects of dry ash disposal on surface and ground waters, and for modeling coal storage pile runoff at utility plants;
- the application of roof-mounted ESP's in the Japanese steel industry;
- wind-tunnel modeling to develop a control strategy for a steel mill coal storage pile, and to evaluate taconite storage pile control techniques; and
- developments in the application of charged fog, road carpeting, wind screens, and a spray charging and trapping scrubber to control particulate matter emissions.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

EP 1.89/2:

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Seymour Calvert, Air Pollution Technology, Inc.

Introduction

The fourth in a series of symposia on the measurement and control of industrial fugitive emissions, sponsored by the Process Measurements Branch (PMB) of EPA's Industrial Environmental Research Laboratory at Research Triangle Park, North Carolina, was conducted in New Orleans, Louisiana, on May 28-30, 1980.

The symposium is part of PMB's continuing effort to develop methods for the measurement and control of airborne and waterborne fugitive emissions from industrial and energy-related processes. It was highly successful in meeting its objective of bringing together representatives of industrial, academic, research, and government organizations with experience or an interest in fugitive emissions problems to exchange information of potential benefit to all.

Twenty-four technical papers were presented by authors representing government agencies, consulting and research organizations, and industry. Each presentation was followed by a short discussion period, during which members of the audience could ask questions of the presenter or provide additional information from their own experiences. Many such discussions carried over to, or were resumed during, coffee break or group luncheon periods.

The texts of the papers, as prepared by each author, are included in the proceedings. Highlights of the presentations are described in the following summary. A more detailed abstract of each paper is presented in the final section of this report.

Summary of Technical Papers

Thompson Pace of EPA's Monitoring and Data Analysis Division described the impact of fugitive emissions on the current EPA regulatory programs and policies. Included were SIP revisions, PSD, NSPS, and NESHAP. A summary of Federal regulations and policies applicable to fugitive particulate matter emissions under the Clean Air Act was presented by David Brandwein of TRC-Environmental Consultants, Inc.

A measurement program to assess the air quality impact of strip coal mining activities was the subject of two papers. James Armstrong of the Denver Research Institute described the use of a tethered balloon in obtaining vertical samples in the emissions plume. David Dietrich of Colorado State University described the surface sampling and meteorological measurements made in CSU's portion of the study.

Other authors described the results of their recent measurement programs of petroleum refinery valves, flanges, and seals; a particle board plant's material handling operations; copper smelter reverberatory furnaces; a pilot scale *in-situ* oil shale retort; and a steel mill. The steel mill program also included laboratory identifications of particulate species that could be used in source/receptor analyses.

A method developed to sample fugitive emissions and determine a mass emission rate from a blast furnace cast house using a multi-point array of hi-vol samplers was described by James Geiger of Betz-Converse-Murdoch, Inc. A sampling program designed to quantify atmospheric emissions from a hazardous waste treatment facility using simultaneous surface and upwind-downwind sampling was the subject of the paper presented by Tim Sekulic, of F.C. Hart Associates.

Two specialized particulate matter sampling devices were described. The first was an isokinetic ambient-air or low-temperature flue gas sampler that uses electrostatic precipitation to collect the particles. A passive directional control that may be added to the device for ambient sampling was included in the description by Bengt Steen of the Swedish Water and Air Pollution Research Institute. The second was a horizontal elutriator for sampling particulate matter in the inhalable size range developed for EPA by the Southern Research Institute.

A technique to determine the effects of utility plant disposal of dry ash on surface and ground waters through laboratory analyses and modeling, and the development of a modeling and monitoring technique to characterize the effects of storm water runoff from a utility coal storage pile were treated in separate presentations. Both presenters emphasized the use of the techniques in establishing design parameters for control systems.

The applications of wind tunnel scale modeling in the development of a control strategy for a steel mill coal storage pile and in the evaluation of water and chemical dust suppressant sprays as controls for taconite storage piles were the subjects of papers by Aivo Veel of the Steel Company of Canada and Robert Jacko, Professor of Civil Engineering at Purdue University.

EPA-sponsored developmental efforts in the control of particulate matter fugitive emissions were the subject of four separate papers. These efforts included a description of the theory of operation of an electrostatically charged fogger and results of its initial wind-tunnel testing; results of wind tunnel experiments to determine the effect of humidity, particle size, wind speed, and pile contour of a model material storage pile on its emissions; results of a field test program to evaluate the effectiveness of road carpet in reducing emissions from unpaved roads; and the results of tests to evaluate the performance of a spray charging and trapping scrubber in controlling emissions from a simulated industrial source.

Abstracts of Technical Papers

Overview of Fugitive Emissions

Thompson G. Pace, EPA/MDAD-RTP

This paper discusses the impact of fugitive emissions on the EPA regulatory programs. Specific attention is given to sources and impacts of particulate matter (PM) and volatile organic compounds (VOC). As background information, the nonattainment status of the particulate matter and ozone National Ambient Air Quality Standards (NAAQS) is discussed. A national emissions inventory which compares and contrasts the emissions from PM and VOC is presented. New emission measurement methods and the impacts of these emissions on air quality are discussed.

Several regulatory programs are concerned with fugitive emissions. State Implementation Plans require the control of PM and VOC to effect compliance with the NAAQS for Total Suspended Particulate and ozone. Regulatory programs such as the Prevention of Significant Deterioration and regulatory policies such as the rural fugitive dust policy and the bubble policy are cognizant of fugitive emissions. The New Source Performance Standards are beginning to regulate fugitive emissions and many pollutants regulated under the National Emissions Standards for Hazardous Air Pollutants are included in fugitive emissions. Each of these is discussed.

Fugitive Emissions Control After Alabama Power

David I. Brandwein, TRC-Environmental Consultants, Inc.

Of the many regulatory consequences of the 1977 Clean Air Act Amendments, one of the most significant is the increased attention they have generated on the fugitive emissions problem. Historically, EPA's implementation of the Clean Air Act has focused on emissions from new automobiles and industrial installations. With respect to nonmobile sources of particulate matter, regulations have been directed primarily at limiting the opacity and mass loading of smokestack emissions from incinerators, fossil fuel-fired boilers, and major process industries. Non-stack particulate controls have traditionally been applied only to open burning and mineral extraction operations.

Recent studies indicate that traditional stack-oriented control strategies for particulate matter are insufficient by themselves to achieve the ambitious air quality goals of the Clean Air Act. Control of industrial fugitive emissions and nontraditional sources of fugitive dust will therefore be an essential ingredient in future control strategies for particulate matter. Control of new, and possibly existing, fugitive emissions sources will also be required in order to comply with EPA's regulations on Prevention of Significant Deterioration (PSD). This paper attempts to summarize the federal regulations and policies applicable to fugitive particulate matter sources under the Clean Air Act. Pertinent provisions of EPA's regulations and guidelines for nonattainment and PSD areas are discussed within the context of the EPA Fugitive Dust Policy. Particular emphasis is given to discussing the impact of the recent Alabama Power decision and the significance of EPA's development of an ambient air quality standard for inhalable particulate matter.

Particle Production from Surface Mining: Vertical Measurements

James A. Armstrong, Denver Research Institute

An investigation of the vertical extent and downwind transport of fugitive dust plumes resulting from various operations at a surface coal mine was conducted using a tethered balloon sampling system. This EPA-sponsored field study took place concurrently with a Bureau of Land Management-sponsored field program conducted by the USDA's Forest Service and Colorado State University to assess the overall air quality impact of strip mine activities on the surrounding environment.

A balloon was used to carry aloft three lightweight wind directional particle samplers. One sampler was attached directly to the balloon; the other two were attached to the tetherline at selected distances from the balloon. This arrangement allowed for the simultaneous collection of dust samples at three heights above the ground at various downwind distances from the mine operation. A fourth sampler was located near the balloon launch site to monitor ground level concentrations. Dust samples were collected on Nuclepore and Millipore filter substrates which were analyzed by optical and scanning electron microscopy.

The size distribution, concentration and composition versus height of the collected dust samples are presented. Time lapse movies of mining activities at the test site during tethered balloon sampling are also discussed.

Particle Production from Surface Mining: Surface Particulate and Meteorological Measurements

David L. Dietrick, Colorado State University

Results from a field study to determine the amount of particulate produced by surface mining activities are presented. These results include: (a) patterns of dry deposition collected on a novel simulated grass surface over a regularly spaced grid of 120 points; (b) suspended particulate collected at two points using Anderson heads on high volume samplers; (c) suspended particulate collected on various filter materials using a number of innovative low volume samplers; (d) turbulence measured at 1, 3 and 15 meters above the surface by Gill u, v, w anemometers; (e) wind, temperature, and humidity profiles up to 450 m on a three times per day basis; and (f) acoustic sounder records among others.

Preliminary results show 24-hour average ambient air particle concentrations on the order of 400-700 $\mu g/m^3$ with greater than 50% below 7 μm in size.

In addition to on-site measurements, an attempt was made to quantify the impacts of surface mining on ambient particulate levels. An integrating nephelometer and a contrast telephotometer were operated from a location some 10 to 12 km distant from the mine site. Estimates of the total particulate production from the mine are made by a combination of modeling and off-site measurements.

Fugitive Emissions Concerns for Coal Storage and Handling at Utility Generating Stations

Peter W. Kalika, TRC - Environmental Consultants, Inc.

This paper discusses the potential impact on utility operations of fugitive particulate matter emissions from coal storage and handling. It is based primarily on a study completed by TRC for a large utility.

Utilities seeking to convert to coal firing or preparing to reactivate older coal systems will be faced with a number of questions, including:

- What are the probable magnitudes of the fugitive emission?
- What types of fugitive emission control systems are available?
- What modeling techniques are available to assess the impact on air quality of fugitive emissions?
- What are the design characteristics of various types of coal handling components with respect to fugitive emission potential?
- What are the ramifications of fugitive emissions control with respect to BACT and LAER under the Clean Air Act?

In developing a fugitive emissions inventory and applying the findings to decisions regarding the feasibility of resuming coal firing, the utility and TRC found it necessary to formulate answers to the foregoing questions. The paper presents discussions related to each of these questions, with the objective of providing a general guideline to the utility managers who must address these problems.

Design, Performance Testing and Field Operation of an Isokinetic Electrostatic Particle Sample

Bengt Steen, Swedish Water and Air Pollution Research Institute

An isokinetic particle sampler for ambient air and low temperature flue gases was built. The sample flow is generated from the kinetic energy of the wind or flue gas. Isokinetic conditions are maintained by balancing the driving forces—the dynamic pressure and an enhanced static pressure—against the friction losses in the sampler. The particles in the sample are collected by means of electrostatic precipitation. When used in ambient air, a wind vane and an opening mechanism may be added so that particles are sampled only within a certain sector. The sampler was tested in a wind tunnel and the results compared with those from conventional measurements. The results normally agree within 10%. The flow rate in the nozzle and outside the sampler was found to agree within a few percent in the entire velocity range that was investigated; 0.5-25 m/s.

The sampler was used for field measurements in roof ventilators above electric arc steel furnaces and around a stock yard of a smelter to determine its fugitive emissions. In the latter case, 1-month samples were taken for a period of 1 year.

Sampling strategy for fugitive emissions involves placing several samplers in the middle of imaginary border surfaces round the source, and pointing each sampler toward the source. Simplified measurements and evaluation procedures are described for ideal point sources, line sources, and surface sources.

Assessing Hazardous Waste Treatment Facility Fugitive Atmospheric Emissions

Tim S. Sekulic, Fred C. Hart Associates, Inc.

A program of sampling and analysis for the identification and quantification of atmospheric emissions and the development of emission factors for all aqueous waste storage, treatment, and disposal processes at a hazardous waste management facility has been developed. Samples for atmospheric emission characterization will be obtained via at least two complementary methodologies, wherever possible, as follows. At the facility's aqueous waste receiving and physical/chemical treatment lagoons, composite liquid samples will be obtained for equilibrium vapor analyses, and *in-situ* surface sampling, using an enclosure technique, will be performed. At the aerated biological oxidation ponds, these methods will be supplemented by an emission profiling method.

The organic vapor content of all air samples will be analyzed with a Century Systems Organic Vapor Analyzer (OVA) with a self-contained gas chromatographic/flame ionization detector system. Initially, OVA analyses will be duplicated using a laboratory gas chromatograph/mass spectrometer for verification and calibration of results. Additionally, impinger absorption samples will be collected for the determination of ammonia, amine, and acidic vapor emission rates.

Measured pond and lagoon emission rates will be used to develop emission factors (mass emission rate per unit of surface area), and mass transfer coefficients will be determined for a theoretical emission rate expression which has been developed. Further, sampling results will be used to identify potentially troublesome (e.g., toxic or odorous) emissions from any process. A meteorological monitoring station is also being installed for correlation of meteorological conditions to sampling results and for future analysis and prediction of atmospheric emission problems.

Sampling results are not yet available for discussion; therefore, concentration

is given to the details of the planned sampling and analytical program and the computation methodology, for characterizing the facility's waste treatment pond and lagoon emissions.

Results of Fugitive Emission Measurements at Refineries and Current Activities in Petrochemical Units

Donald D. Rosebrook, Radian Corporation

Final results of fugitive emissions monitoring in petroleum refineries are presented as a series of emission factors for valves, flanges, pump seals, compressor seals, relief valves, and drains. The emission factors appear to be dependent on the type of service in the line, consequently the emission factors have been developed for gas/vapor, light liquid, and heavy liquid service. No dependency on temperature, pressure, or line size was noted. Extensive quality control data allowed the calculation of confidence intervals for all emission factors. Correlations between a hydrocarbon "sniffer" value and measured mass emissions rates in pounds per hour are given.

Currently EPA is sponsoring studies in the synthetic organic chemicals manufacturing industry. The current program includes both screening and sampling selected valves and pumps and screening *all* "baggable" sources in a variety of chemical manufacturing units. The screening studies are being conducted by four separate EPA contractors, Radian, PEDCo, TRW, and Acurex, with Radian doing all data reduction. Screening data for target chemicals are being obtained from at least two different sites if possible. Sampling data are being obtained for three chemicals at two sites each. Correlations between the hydrocarbon "sniffer" value and the mass emission rate are being developed. Studies of the effect of maintenance on leak rate for valves are also being conducted. Hydrocarbon sniffer response factors are being developed for over 100 chemicals with respect to known concentrations of methane.

Evaluation of Fugitive Emissions at a Large Wood-Products Plant

Peter D. Spawn, GCA Corporation

This paper discusses the methodology and results of a study which directly sampled fugitive particulate emissions from material handling operations at a large Northwestern particle board plant. Previous studies had indicated that fugitive particulate emissions may be primarily responsible for severe violations of ambient TSP standards which were recorded in the local neighborhood. The study determined the contribution of fugitive emissions to ambient TSP levels and also investigated fugitive emission control techniques applicable to the process.

Major sources of fugitive emission from the process were large open doorways in several material storage and handling buildings. Emissions from these buildings were directly sampled during a 2 week field program. Replicate samples were collected by traversing the open doorways with a specially designed sampling device similar to a Rader probe. Both total particulate and fine (less than 10 μm) particulate emission rates were determined for a variety of process operations.

Concurrent with direct sampling of fugitive sources, upwind/downwind hi-volume air sampling was conducted outside of plant boundaries. Wind actuated units operating adjacent to continuous 24-hour hi-vol units enabled estimates to be made of ambient air quality and also the overall plant contribution to ambient TSP.

Results of the study provided emission rate estimates for fugitive particulate sources on an annual and hourly basis, including emission rates for various modes of process operation. Control technology applicable to the large material handling buildings was identified and their effectiveness assessed. Control approaches for numerous minor sources of fugitive emissions were also developed.

A Method for Measuring Fugitive Emissions from Cast House Operations

James H. Geiger, Betz-Converse-Murdoch, Inc.

An attempt to measure fugitive emissions from blast furnace cast house operations presented a variety of problems. A method was developed to determine a mass emission rate. The method utilizes high volume samplers placed in a multipoint array at which temperature and velocity measurements are also made. The reasoning behind the method is discussed and the method is compared to other state-of-the-art methods relating to fugitive emission measurements. Results indicate that the method is a reasonably accurate way of determining mass emission rates from cast house operations. The relationships between emissions, process conditions, and opacity observations were investigated. Certain factors which affect the emission measurements are identified.

A number of measurement programs are discussed and, although the basic equipment has remained the same, the methodology has undergone revision. The method is currently being used in an ongoing program of quantifying emissions from cast houses and is continually undergoing refinement.

Steel Mill Particulate Characterization and Source/Receptor Analysis

Philip A. Russell, Denver Research Institute

This study (1) characterized particulate emissions from fugitive sources within a steel mill to determine their potential to be utilized as relatively unique environmental indicators, and (2) determined their relative presence and quantity in the ambient environment within a region near the plant. Analyses were made using scanning electron microscopy/energy dispersive X-ray spectroscopy (SEM/EDS) and transmission electron microscopy/selected area electron diffraction (TEM/SAED). Distinct species of particulates were identified which could be useful in source/receptor analyses. These include carbon particles produced during coking, open hearth, and blast furnace operations; iron spheres produced during blast furnace and open hearth operations; angular Fe and Fe-rich particulates produced during sintering plant operation; potassium/sulfur-rich particle type only in the slag flush and slag tap sections of the blast furnace; and encapsulated iron particles produced by door leaks after slag charging. Examination of ambient samples further demonstrated that the carbonaceous particles and iron spheres produced by the steel mill were the best environmental indicators in the vicinity of the steel mill itself.

Development of Horizontal Elutriators for Sampling Inhalable Particulate Fugitive Emissions

Kenneth M. Cushing, Southern Reasearch Institute

The U.S. Environmental Protection Agency is required, under the amended Clean Air Act of 1977, to review the scientific basis for the total suspended particulate ambient air quality standard and determine whether a revised particulate standard can be promulgated by December 1980. It has been recommended that research to develop information for a size-specific standard should focus on inhalable particulate matter, defined as airborne particles $<15\mu$ aerodynamic diameter. This particle size range relates to that fraction of particulate matter which can primarily deposit in the conducting airways and the gas exchange areas of the human respiratory system during mouth breathing.

This paper addresses the efforts of Southern Research Institute under contract to EPA/IERL-RTP to experimentally apply horizontal elutriation to specific methods for sampling instack, ambient, and fugitive inhalable particulate emissions. Theoretical and experimental data are shown. Results of the application of horizontal elutriation for the initial collection stage of the Fugitive Assessment Sampling Train developed by TRC-Environmental Consultants are presented.

Techniques for Evaluating Surface and Ground Water Effects of Dry Ash Disposal

James F. Villaume, Pennsylvania Power and Light Company

Utilities are finding it necessary to switch to dry fly ash handling to minimize water quality impacts. At the same time, regulations regarding solid waste disposal are becoming increasingly more stringent. In switching from a wet sluiced system to dry ash disposal at the Montour Steam Electric Station, Pennsylvania Power and Light Company required data as to the surface and ground water effects of ash disposal for both design and permit purposes. To provide these, a study program of laboratory testing and computer modeling was conducted in conjunction with a detailed site investigation.

Three types of laboratory testing were involved. They included an extraction leachate test to assess ash variability; a serial batchwise extraction test to determine ash leachate quality and potential ground water effects; and a runoff simulation. To determine runoff quality the simulation results were then used as input into a modified version of EPA's SSWMM computer model.

The paper discusses the testing techniques and describes how the program results were incorporated into the disposal site design and plan of operations

Measurement of Fugitive Emissions from Inco's Copper Cliff Smelter Reverberatory Furnaces

Alan D. Church, Inco Metals Company

The Copper Cliff Smelter of Inco Metals Company, a major primary nickel and copper producer, is located in Ontario, Canada. The essential processing equipment consists of Multi-Hearth Roasters (~30), Reverberatory Furnaces (6), an Oxygen Flash Furnace, and Pierce-Smith Converters (18). A comprehensive program to measure fugitive emission of sulphur dioxide, sulphuric acid, and particulates from the smelter is being undertaken. This paper describes the reverberatory furnace section of this program.

Total fugitive emissions of sulphur dioxide, particulates, and sulphuric acid from the reverb furnaces were measured as 15.2, 0.19, and 0.12 kg/mg of bessemer matte equivalent, respectively. Nearly 70% of the emissions occur during matte tapping. Slag skimming and furnace "puffing" contribute 20% and 3%, respectively. Total fugitive sulphur dioxide emissions were found to be equal to those being emitted by all the converters (previously measured). However, most of the fugitive gas ~90%) was captured at source by hood systems before release to atmosphere at roof level.

Control of Fugitive Emissions from Coal Storage Piles

Avio E. Veel, The Steel Company of Canada, Limited

The Steel Company of Canada is a fully integrated steel producer with its primary steelmaking facilities located in Hamilton, Ontario. The basic end of this operation consists of four coke batteries, four blast furnaces, one OH shop, and one BOF shop.

During the period of December to March when the Great Lakes and the St. Lawrence Seaway are ice bound, shipping of raw materials is curtailed and both iron ore pellets and coal must be stockpiled to allow for continuous operations. At any one time approximately 83 acres of land is covered by up to seven distinct coals or coal blends. Because the percent age of fines can be as high as 15 percent, coal dust particle movement by the wind can be severe.

MHTR Engineering was retained to examine the situation and to recommend measures to alleviate the existing conditions. This study was based on constructing models of the site and testing them in a wind simulator to determine the problem areas and to test the remedial solutions.

The study indicated that orientation and shaping of the coal piles were key factors in controlling the turbulence which resulted in particle movement.

Suggested solutions which have been implemented have significantly reduced the problems associated with storage of coal in open sites.

Use of Roof Mounted Type ESP's in Iron and Steel Industries in Japan

Senichi Masuda, University of Tokyo

About 20 units of the roof-mounted type ESP's have been manufactured in Japan. Most of them are in use in the iron and steel industries for controlling fugitive emissions from blast furnaces, BOF's, electric furnaces, etc. Most of these ESP's are equipped with water irrigated conductive plastic plates as the collecting electrodes, while some of them are dry. The results obtained so far have been extremely successful when suitable precautions are taken for tightening of emission sources and well designed duct systems are used. The construction of the roof-mounted ESP's is described and the operation problems are presented.

Fugitive Hydrocarbon Emissions from an In-Situ Oil Shale Retort

Gerald M. Rinaldi, Monsanto Research Corporation

Oil shale has been recognized as a potentially substantial energy resource in the United States for more than a

century. An emerging technology for shale oil production is *in-situ* processing, in which the shale bed is hydraulically or explosively fractured and retorting is carried out underground. In order to assess potential environmental impacts from *in-situ* processing, data were collected on fugitive emissions from a pilot-scale retort producing 30 barrels of crude shale oil daily. Fugitive gas seepage through the retort surface and from around instrumentation well casings was measured using a specially designed sampling system in conjunction with gas chromatographic and Orsat analysis Total hydrocarbons, C_1 through C_6 hydrocarbon fractions, and carbon monoxide were quantified in the fugitive emission samples. Normalized fugitive hydrocarbon emission rates due to seepage through the overburden ranged from 0.2 to 18 $g/m^2/hr$, with an average of 5.5 $g/m^2/hr$. The total hydrocarbon emission rate due to ground seepage was calculated to be 5.7 kg/hr, using the retort surface area of 1,043 m^2; fugitive hydrocarbon emissions due to leakage around well casings amounted to an additional 0.3 kg/hr.

A Wind Tunnel Study of Fugitive Dust from Taconite Storage Piles

Robert B. Jeko, Purdue University

A comparative wind tunnel study of the fugitive emissions from a taconite pellet test surface conducted at Purdue University indicates that one of the three commercially available dust suppressing agents tested at a dilution ratio of 1 to 1000 was 33% more effective than the least effective agent. Water only was also found to be as effective as the dust suppressing agents. However, water and dust suppressing agents resulted in 3 times higher particulate emissions than those of a dry pile. Both dry and wet transient tests elucidated the nature of the particulate release. For the wetted pellets, subsurface drying appears to "mobilize" interstitial and surface pellet material which results in a higher release rate of particulate matter in time as compared to a dry pellet.

Computing Design Characteristics for Coal Pile Drainage Treatment

Pamela B. Katz, TRC-Environmental Consultants, Inc.

Under Section 304(e) of the Clean Water Act, the U.S. EPA is developing a program of Best Management Practices (BMP's) for control of toxic and hazardous discharges from ancillary industrial sources. These sources include plant-site runoff, spills and leakage, sludge or waste disposal, and raw-material drainage.

For many electric utilities, BMP means evaluating coal storage piles with regard to the quantity and quality of storm related and dry weather drainage. Coal pile drainage is usually characterized as acidic with concentrations of trace metals, iron, sulfur, and solids.

TRC is developing a mathematical model to simulate coal pile drainage for the design of appropriate treatment systems. The model will allow for the consideration of various antecedent meteorological conditions including rain and snow precipitation, freeze/thaw phenomena, and air temperature. Other hydrologic phenomena the model will evluate are: pile runoff, snowmelt, percolation, infiltration into ground water, and evaporation.

The model will also simulate coal pile runoff quality. Components included are framboidal pyrite oxidation, acid production, and the subsequent release of trace metals.

TRC will discuss how its model is one available method to characterize coal pile runoff under varying meteorological conditions. TRC is currently developing an extensive field program at a number of utilities to calibrate and verify the model.

Emissions and Effluents from Rail and Truck Tankcar Cleaning

Thomas R. Blackwood, Monsanto Corporation

As many as 700 different commodities are handled by rail or truck tank cars. Approximately 37,000 railcars and 5,000,000 tanktrucks are cleaned each year by industry and service companies. Air emissions of hydrocarbons can be as high as 2.4 kg for tankcars and 310 g for tanktrucks. Viscosity and volatility are the primary influencing factors on emissions.

If untreated, cleaning solutions from this process could exceed 2,500 metric tons/year of oil and grease in the wastewater. Hydrocarbon emissions to the air could also exceed 620 metric tons/year or about 0.0022% of U.S. emissions. Practical and economically feasible control for air emissions does not exist except for combustible gases and water-soluble vapors. State-of-the-art technology for wastewater effluents does exist but the effectiveness is widely variable and is very expensive.

This report describes the state-of-the-art practice in mobile tank cleaning. Composition, estimated quantities, and rate of emissions and pollutants are described along with control methods and costs.

A New Concept for the Control of Urban Inhalable Particulates by the Use of Charged Fog

John S. Kinsey, AeroVironment, Inc.

This paper is directed to those scientists and engineers concerned with the control of fugitive particulates in the inhalable size range ($<15\ \mu m$) from non-traditional sources in the urban environment. A new type of electrostatically augmented spray nozzle (fogger) is described which is intended to achieve a target control efficiency of 90% for inhalable particulates. The theory of operation is explained, along with a physical model for predicting the control efficiency of the fogger. Results of preliminary wind tunnel tests are presented showing the degree of control actually achieved by the fogger for various operating modes. Finally, plans for additional modifications to the fogger are discussed which incorporate the information gained from preliminary testing in the wind tunnel.

Control Method for Fugitive Area Sources

Dennis J. Martin, TRC - Environmental Consultants, Inc.

The prime control techniques for fugitive area sources are water sprays, enclosures, wind screens, and chemical stabilizers. A review of the literature indicated that while cost data were readily available for these methods, estimates of their efficiencies were not supportable from the given data. Nonetheless, future work on wind screens and chemical stabilizers appears warranted. An ongoing field study of a wind screen made of a synthetic material indicates that efficiencies of over 60 percent should be obtainable at a reasonable cost when applied to storage piles.

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Civil Engineering Fabrics Applied to Fugitive Dust Control Problems

Dennis C. Drehmel, EPA/IERL-RTP

Civil engineering fabrics are in common use for a number of purposes including: 1) ground stabilization; 2) subsurface drainage; 3) railroad construction and maintenance; 4) sediment control; and 5) erosion control. Fabrics are available from Celanese, DuPont, Monsanto, and Philips Fibers under the trade names of Typar, Bidim, Supac, and Mirafi. Use of these fabrics for air pollution control is a recent development and the subject of recent and future field tests.

Reduction of emissions from unpaved roads is achieved by covering the road first with the fabric and then with coarse aggregate. Unpaved parking lots, inactive piles, and construction sites could be controlled in the same way. During tests in November 1979 on an unpaved road constructed with Bidim, the average reduction in TSP was 58% and in inhalable particle concentrations was 46%. More tests are planned at both eastern and western sites in the spring of 1980 and a year-long monitoring at a western site will begin in the summer of 1980.

C. S. Wibberley is with TRC—Environmental Consultants, Inc., Wethersfield, CT 06109.

***D. Bruce Harris** is the EPA Project Officer (see below).*

The complete report, entitled "Proceedings: Fourth Symposium on Fugitive Emissions: Measurement and Control (New Orleans, LA, May 1980)," (Order No. PB 81-174 393; Cost: $32.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650

The EPA Project Officer can be contacted at:

Industrial Environmental Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

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